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ABSTRACT

A study tested the assumption found in schema theory that scripted knowledge automatically provides specific content details about scripted activity, thereby biasing a reader's immediate interpretation of a text. The study measured how quickly and accurately 16 college students could verify script related words. Subjects listened to four scripted texts, two of which occurred normally (total) and two of which were segmented into thirds (segmented). At each break point, the subjects were tested for recognition of three types of words: (1) explicit--those mentioned in the text; (2) implicit--those logically required but not mentioned; and (3) unrelated. The results showed equivalent response times for explicit and implicit words, though both were slower than those for unrelated words. Errors involving implicit words were significantly more probable than for other words. The results support the hypothesis that content of a script automatically biases the reader's comprehension processes. (Author/FL)

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Using Memory Schemata to Comprehend Scripted Texts

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Using Memory Schemata to Comprehend Scripted Texts

Recently, a growing body of research has dealt with how people learn and remember information in texts. One line of this work has been concerned with the concept of a schema. This research has addressed the human knowledge structures (or schemata) that guide prose comprehension and memory (Kintsch, 1977; Kintsch & van Dijk, 1975; Mandler, 1978; Mandler & Johnson, 1977; Rumelhart, 1975, 1977; Stein & Nezworski, 1978; Thorndyke, 1977, 1978). A schema has been defined as a cluster of knowledge that describes the typical properties of a generic concept. This cluster is comprised of a set of concepts and associations that together describe the knowledge structure in question (Thorndyke & Yekovich, 1980).

Although the notion of schema has been operative in psychology for well over fifty years (Bartlett, 1932; Head, 1920; Woodworth, 1938), empirical research has not yet provided cognitive psychologists with detailed assumptions concerning the activation and use of schemata during comprehension. A detailed understanding of these processes is necessary to develop a complete theory of human memory for text. The current study is a beginning in that direction.

When an individual is either orally or visually receiving textual information, the encoding process presumably biases the interpretation of the text because of the general domain

knowledge of the concept that the individual brings to the situation. As a consequence, memory for text is best described as a mixture of organized textual content, and also the particular domain specific knowledge the individual posesses for the topic in question. The idea that domain specific knowledge (i.e., a prototypical structure representing the semantics of a concept) act as interpretive frameworks has been proposed by several researchers (e.g., Anderson, 1977; Anderson & Pichert, 1978; Anderson, Reynolds, Schallert, & Goetz, 1977). For instance, the term "script" has been used to describe a domain-specific knowledge structure that represents a frequently enacted activity, such as painting a room (Schank & Abelson, 1977). Presumably, the script not only provides a structural framework for organizing the input information, it also provides defaulted instantiations for the slots in the structure. That is, the activation in memory of a "Painting the Room" script, not only provides categories such as materials, surfaces for painting, and procedures. Additionally, the activated script "fills-in" the slots automatically with high probability instantiations (e.g., paint, brushes, walls, moving furniture). As a consequence, when an individual reads a scripted text about painting, the script is supposedly triggered for use in organizing the input propositions and also for "filling" the incomplete text through automatic inference processes. Although this hypothesis has been informally accepted by many theorists (Rumelhart & Ortony, 1977; Schank & Abelson, 1977; Graesser, Gordon & Sawyer, 1979), no empirical evidence has been presented

to support these claims. In fact, little research to date has been able to demonstrate directly that schemata (or in this case, scripts) are operative during encoding.

The purpose of the experiment reported here was to test the script activation hypothesis in the following way. Subjects were instructed to listen to four highly scripted texts which were presented in either a total or a segmented version. In the Total version the passage was read to the subjects in it's entirety; in the Segmented version the discourse was broken up into approximately three equal parts. The purpose of this manipulation was to influence the amount of script-content stored in immediate memory.

At each break point (i.e. , after an entire story or after each third), subjects were tested for recognition of certain types of words. The test words included EXPLICIT words-- those that were present in the script; IMPLICIT words-- those that were not present in the script but were directly related or should be automatically inferred as a result of script activation; and UNRELATED words-- those words that were entirely unrelated to the script. Both verification latencies and response choices were recorded.

If script knowledge biases the encoding of texts describing stereotypical event sequences, predictable patterns of verification times and errors should occur.

The decision time predictions are not straightforward. The simplest idea would be that because of automatic activation of high probability default values, approximately equal search times will be required for EXPLICIT and IMPLICIT information. However, this prediction can be complicated by two factors. First, the level of activation may be different for EXPLICIT and IMPLICIT items, due to the extra activation given by the surface trace. This would favor EXPLICIT items. Second, the copy of the scripted knowledge that is used to interpret the text may be either full or partial (see Bower, Black, & Turner, 1979). The form of copy would influence which script contents are activated and this could also produce an advantage for EXPLICIT items. If either or both the levels assumption and copy form assumption are considered, the decision time patterns should show IMPLICIT>EXPLICIT>UNRELATED.

With respect to errors, EXPLICIT items should suffer from being correctly identified because subjects will have difficulty in discriminating between EXPLICIT and IMPLICIT terms. However, the surface representation of the script should reduce this confusability somewhat. Conversely, the automatic activation of high probability exemplars which were not actually stated (i.e., IMPLICIT's) should cause reduced discriminability, and thus higher error rate patterns. Presumably, in the Segmented version, subjects will be better able to determine the exact contents of memory. This should show up in differential error patterns for the two presentation formats. Finally, the UNRELATED error rate should be near zero since subjects should

easily identify these words as being irrelevent to the activated script.

METHOD

SUBJECTS

The subjects were 20 Catholic University undergraduates from an introductory educational psychology course. Data from three subjects were discarded because of either subject or experimenter error. A fourth subjects' data was randomly chosen to be excluded to maintan a completely counterbalanced design.

MATERIALS

Passages. The study utilized four passages each of which described highly stereotypical sets of events. The passages were one paragraph in length ranging from 150 to 200 words. The passages had a central figure, Jack, and four themes common to the college population. The themes were as follows: Jack applying to college, going to the library, painting his living room, and taking his girlfriend to a restaurant. The restaurant passage was a modified version of a text from Graesser et al., (1979). The other three were constructed by the authors. The four passages were recorded on an audio tape in their total form with the male speaker saying stop after completion of the passage. The passages were also recorded on tape segmented into thirds with the speaker saying stop after each segment.

Word Lists. Word recognition for each passage was tested by a set of 30 words. Each word list was comprised of 10 words totally unrelated to the passage (UNRELATED), 10 words that were mentioned explicitly in the passage (EXPLICIT) (e.g., paint), and 10 words that could be logically inferred from the content of the passage but were not explicitly stated in the passage (IMPLICIT) (e.g., walls).

DESIGN

The design was a repeated measures factorial with presentation mode (Total, Segmented) and word type (EXPLICIT, IMPLICIT, UNRELATED) as the independent variables. Passage (College, Library, Painting, Restaurant) was analyzed separately as an independent variable. The dependent variables were decision time and number of errors.

Subjects were randomly assigned to counterbalanced conditions. Half of the subjects received the first passage in the Total mode. The remainder started with Segmented. The remaining three passages for each person alternated in presentation mode.

PROCEDURE

Subjects were tested individually. Instructions told the subjects that we were interested in the process by which people remember material. The subjects were also informed that they would be listening to four taped passages, two of which would be presented in Total form (i.e., without interruption) and two in the Segmented form. The individuals were told to listen carefully since they would be tested for recognition memory of the words in each of the passages. These instructions emphasized the importance of remembering the exact words that occurred. Subjects were told that they should respond YES only to words that they heard mentioned in the text, and NO to all others.

After the instructions were read to the subject, the experimenter instructed the subject on the use of the tachistoscope (used for the word recognition test). Next, a practice passage in Total form was presented on the cassette recorder and then subjects were tested for their recognition. They were told to respond as quickly and accurately as possible. The experimenter presented the items individually in the tachistoscope and recorded the latencies and responses. The approximate inter-item interval was 10 seconds. After the word recognition list for the practice passage, the experimenter resolved remaining questions and proceeded with the experimental passages. This presentation-test process was repeated in the same manner until all four passages were completed. The experiment lasted approximately 40 minutes.

RESULTS

Table 1 summarizes the mean decision times and proportion of errors for the six experimental conditions.

Insert Table 1 about here

An analysis of variance was performed on the passage variable and no main effects were significant. The interaction of passage and word type was significant, F (6,90) = 3.24, $p<.01$. This was due merely to the difference in the magnitude of the effects across passages and not in the differential patterns. Consequently, further analysis were computed collapsing across the passage variable.

Next, an analysis was conducted comparing total decision times for presentation mode and word type. This analysis was performed on all items, regardless of item correctness. There were no significant effects for presentation mode or the interaction. Significance was found for word type, F (2,30) = 16.26, $p<.01$. A Newman-Keuls test declared that reaction time for UNRELATED words ($\bar{X}$ = 1.477) was significantly shorter than EXPLICITS ($\bar{X}$ = 1.6780) and IMPLICITS ($\bar{X}$ = 1.788) which did not differ at $p<.05$. This finding supports the simple hypothesis that, when correctness of decision is discounted, search time was equivalent for script-related information.

The third ANOVA was performed on the response times for correct decisions. These responses consisted of answering YES to an EXPLICIT item, and NO to both IMPLICIT and UNRELATED items. The purpose of this analysis was to determine the extent to which correct rejections of IMPLICIT's required additional decision time. Logically, the discrimination of activated EXPLICIT and IMPLICIT information should create an interference effect in which judging the correct absence of IMPLICIT information takes longer. The only significant effect was for item type, F (2,30) = 9.26, $p<.001$. A Newman-Keuls test declared the following pattern: IMPLICIT>EXPLICIT>UNRELATED at $p<.05$. This confirms the hypothesis that, even though a correct decision was made, IMPLICIT items still took significantly longer than EXPLICIT and UNRELATED items.

The above analyses are not indicative of the response patterns when subjects thought that an IMPLICIT item was actually present. A more sensitive decision time analysis would be to consider the script-relevent words for which people respond "YES"; that is, responding correctly to EXPLICIT's and incorrectly to IMPLICIT's. This gives some idea of the time required to respond to an item that was thought to have been heard. Since there was a 95% accuracy rate for UNRELATED's, they were not included in this analysis. As table 1 shows, EXPLICIT times were faster than IMPLICIT times ($p<.05$). These findings also suggest an effect of confusion or interference (see also Lewis & Anderson, 1976).

Finally, a 2x3 analysis of variance was performed for errors. The presentation mode effect was significant, F (1,15) = 13.97, $p<.05$. As Table 1 exhibits, the false alarm rate was greater on the Total passages than the Segmented passages. This is consistent with the idea that surface memory influences recognition accuracy (see also McKoon, 1977). The effect for word type was also significant, F (2,30) = 65.55, $p<.01$, as was the interaction of presentation X item type, F (2,30) = 5.65, $p<.001$. The Newman-Keuls ($p<.01$) revealed significantly greater number of errors for IMPLICIT words than for EXPLICIT or UNRELATED words and significantly more errors on EXPLICIT items than UNRELATED items (i.e., IMPLICIT>EXPLICIT>UNRELATED for each presentation mode $p<.05$). Additionally, the differences between EXPLICIT, IMPLICIT and UNRELATED words were much larger in Total passages than Segmented passages (see Table 1). Finally, errors increased dramatically for IMPLICIT items across presentation modes, t (15) = 6.46, $p<.01$. This increase was much smaller for the other word types; for EXPLICIT, t(15) = 2.52., $p<.05$; for UNRELATED, $t<1$.

DISCUSSION

Several interesting and predictable results consistent with a knowledge activation view surfaced in this experiment. First, when total reaction times were considered (i.e., regardless of correctness), no difference between IMPLICIT and EXPLICIT words occurred, though both would be significantly longer than the UNRELATED words. These data provide suggestive confirmation for the idea that people search an activated script during

recognition. That is, because the scripted activity knowledge structure was activated during encoding, words that did not appear in the text, but could be logically inferred, were treated, in essence, as though they had explicitly appeared in the text. Search time was equivalent in either case.

Second, correct decision times showed an interference effect for IMPLICIT items that resulted in longer decision times for IMPLICIT than for EXPLICIT items. This demonstrates that because of the level of activation of inferred script information, subjects took considerably longer to correctly decide on IMPLICIT items than they did for EXPLICIT items.

We also observed that when the search for the IMPLICIT item ended with an incorrect decision (answering YES), this process also took significantly longer than when the search for the EXPLICIT item ended with a correct decision (answering YES). One possible explanation for this is that even though the IMPLICIT items were not included in the text, they were so plausible that subjects conducted an exhaustive search for the item. As expected, when the search for the IMPLICIT item ended incorrectly (answering YES), it ended more quickly than when the correct decision was given (answering NO). This trend can be seen by comparing the correct decision times for IMPLICIT's with the error times for those items. Unfortunately, this is not significant.

Finally, and most importantly, more errors occurred for IMPLICIT than for EXPLICIT items. The overall 40% error rate for IMPLICIT items demonstrates that the activation and use of conceptual knowledge, created substantial discrimination problems for our subjects. In fact the 33% decrement in the SEGMENTED condition suggests strongly that immediate memory was contaminated by long-term script specific content. This data is perhaps the most convincing aspect of the knowledge activation idea.

We must acknowledge, however, that one conceivable explanation for the pattern of data as a whole could be that people don't activate scripts at all. Perhaps, what took place was a form of recognition confusion (James & Hillinger, 1977) for simple associations among concepts which occurred because of the task. However, this association confusion explanation does not seem to coincide with the above results. In it's strictest form, this idea would posit that EXPLICIT error rates would parallel those of IMPLICIT's. That is, if confusion occurs at the associationistic level, and if surface traces fade predictably then error rates between IMPLICIT and EXPLICIT items should fade in a parallel manner across presentation mode. The interaction between presentation and item type rules out this parallel effect.

One area for future research would be to look at the factors which might influence the conceptual versus lexical tradeoff that occurred with the difference in error rates for Total and

Segmented modes. A more accurate method for measuring this activation would be the priming procedure. Another area concerns exactly how much of a script is activated, scenes or the whole event sequence?

Another factor that we did not control that might have influenced the above results is the criticality or importance of the items to the script. Currently we are investigating the importance of this variable (see also Bower et al., 1979; Graesser, et al., 1979).

In summary, we have demonstrated that scripts are activated and used to supplement text information resident in immediate memory. Two implications of this work for successful reading comprehension are obvious. First, if readers either do not possess the appropriate domain-specific knowledge, or they do not activate and use that knowledge during reading, they are likely to exhibit comprehension failure. Second, the automatic activation of appropriate knowledge is likely to aid in drawing inferences from a text. This, of course, leads to successful complex reasoning about what one reads.

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Table 1

Mean Response Times and Proportions of Errors
for the Six Experimental Conditions

PRESENTATION FORMAT/ Dependent Measure	Item Type		
	Explicit	Implicit	Unrelated
TOTAL			
Correct Decision Time	1.697	1.870	1.473
Time to Respond "YES"	1.697	1.808	-----
Errors	.20	.46	.06
SEGMENTED			
Correct Decision Time	1.587	1.850	1.420
Time to Respond "YES"	1.587	1.811	-----
Errors	.15	.33	.03
MEAN			
Correct Decision Time	1.642	1.860	1.447
Time to Respond "YES"	1.642	1.810	-----
Errors	.18	.40	.05